

PRELIMINARY DATA SUMMARY

September 1987

U.S. Army Engineer Waterways Experiment Station  
Coastal Engineering Research Center  
Field Research Facility  
Duck, North Carolina

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### CERC Field Research Facility Duck, North Carolina

This report provides a summary of basic oceanographic, meteorological and bottom profile data for the month. The data were obtained as part of the Field Research Facility Measurement and Analysis Work Unit at the U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's Field Research Facility in Duck, North Carolina. The data were collected and the analyses performed by the FRF staff. These summaries are intended to make the data readily available to all FRF users, and comments on their content and usefulness are invited.

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## I. INTRODUCTION

The U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's (CERC) Field Research Facility (FRF) is located on the Outer Banks of North Carolina, near the village of Duck (Fig.1).

The FRF research program provides a means for obtaining high-quality field data, particularly during storms, in support of the U.S. Army Corps of Engineers' coastal engineering research missions. The FRF consists of a 561-m (1,840 ft) long concrete research pier supported on 0.91 m (3 ft) diameter steel piles. The pier deck is 6.1 m (20 ft) wide, 7.74 m (25.4 ft) above mean sea level (MSL), and extends from behind the dunes to approximately the 7.6 m (25 ft) depth contour. In addition, a main building contains offices, an instrument repair shop, and a data acquisition room.

One of the responsibilities of the FRF research program is the collection, analysis and dissemination of data on local oceanographic and meteorological conditions. Bottom profiles along both sides of the pier and periodic bathymetric surveys are also performed.

This summary is intended to provide basic data as soon as possible after they are obtained. Most of the data are daily observations or the results of preliminary data analysis. In many instances, continuous analog records and more extensive analyses will be made available later by the CERC Coastal Engineering Information and Analysis Center (CEIAC).

Table 1 is a list of instruments used, their status during the month, and the data collection status. Figure 2 identifies the location of the instruments. The water depth at the wave gages and current meters vary and may best be determined from the information contained in Figure 8. Other installation information is contained in Table 1. All times unless otherwise specified are referenced to Eastern Standard Time (EST).

Section II presents the meteorological data; Sections III through VI, oceanographic data; Section VII, nearshore profiles and bathymetry; and Section VIII, if included, documents special events that occurred at the FRF during the month.

Questions and/or comments concerning the data may be directed to Mr. Herman C. Miller at (919) 261-3511.

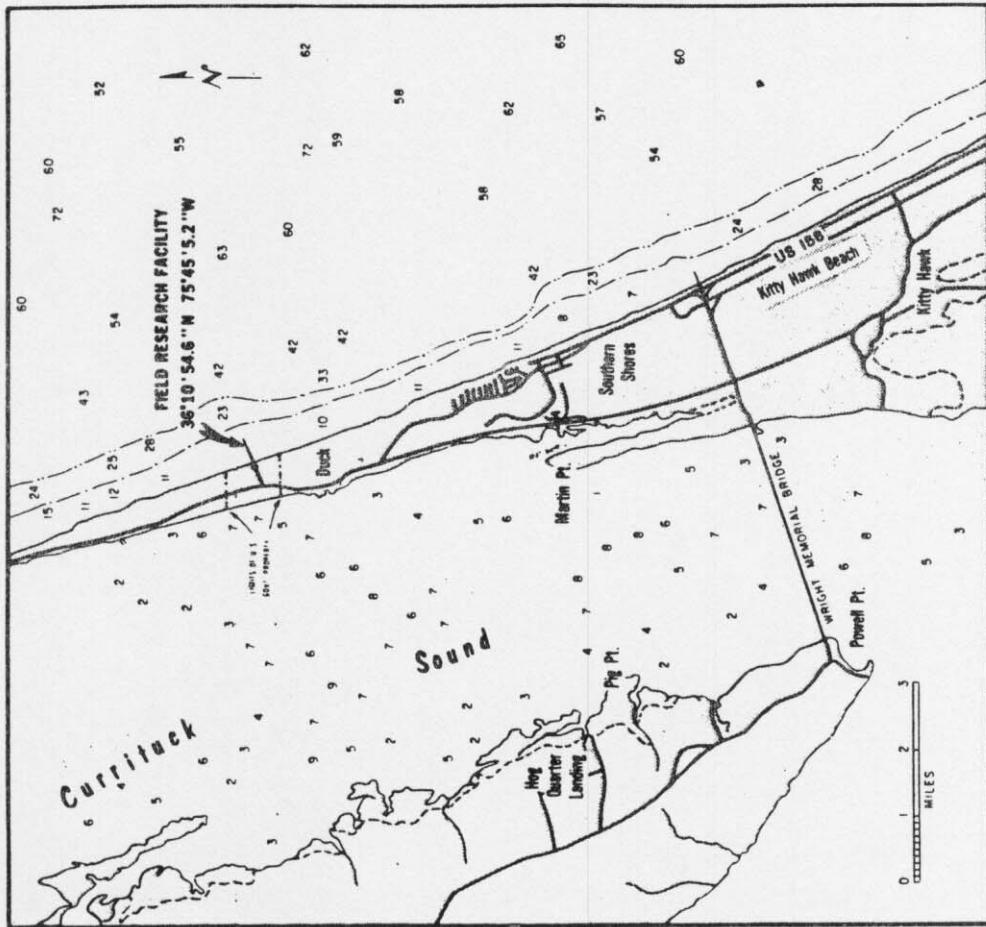
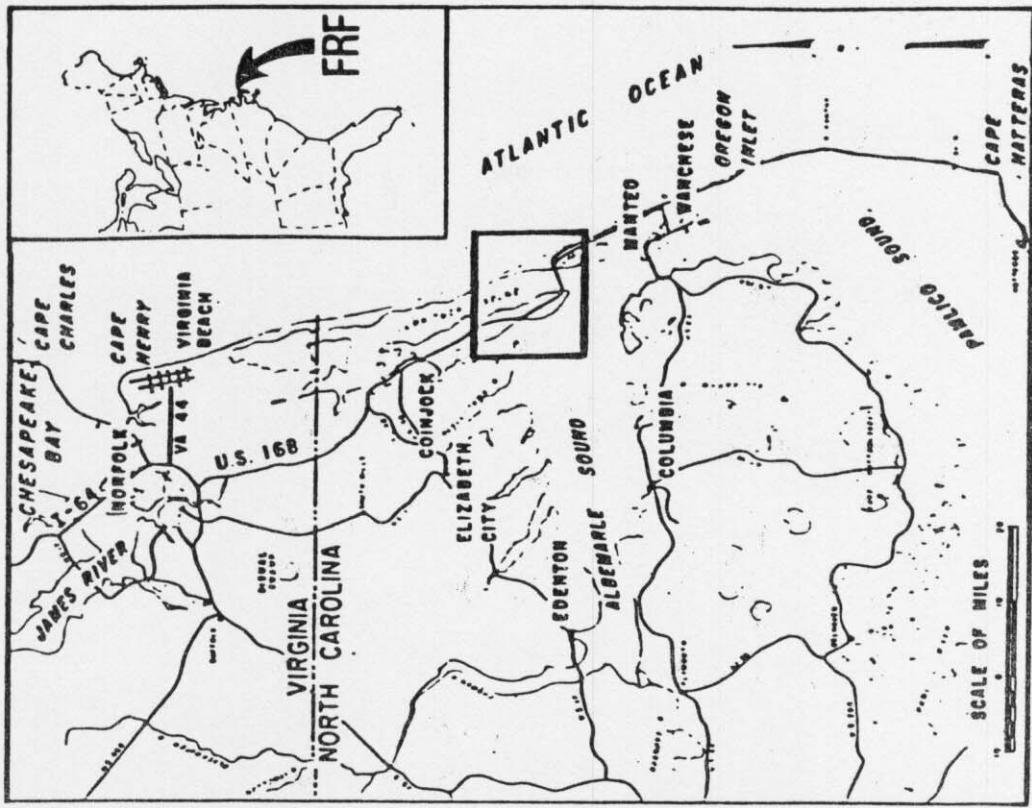


Figure 1. FRF location map.

TABLE 1  
INSTRUMENT STATUS/DATA AVAILABILITY

September 1987

DAY OF THE MONTH  
1/2/3/4/5/6/7/8/9/10/11/12/13/14/15/16/17/18/19/20/21/22/23/24/25/26/27/28/29/30/

CAGE NUMBER	DESCRIPTION/REMARKS	DEPTH AT SENSOR	Instrument Status		
			Data Collected	Analog Record	Instrument Status
	Barometric Pressure		Data Collected	Analog Record	Instrument Status
			Data Collected	Analog Record	Instrument Status
Precipitation			Data Collected	Analog Record	Instrument Status
Air Temperature			Data Collected	Analog Record	Instrument Status
	Anemometer on Lab Bldg - Elevation 19m (MSL)		Data Collected	Analog Record	Instrument Status
645	Baylor staff located at station 6480 on FRF pier	See profile data	Data Collected	Analog Record	Instrument Status
625	Baylor staff located at station 19400 on FRF pier	See profile data	Data Collected	Analog Record	Instrument Status
111	Pressure gage located 207 m north of FRF pier (0.9 km offshore)	Approx. 7.8 m MSL	Data Collected	Analog Record	Instrument Status
630	Waverider buoy located 6.0km from shore	Approx. 18 m MSL	Data Collected	Analog Record	Instrument Status
679	Current meter 500M south (0.5km offshore)	Approx. 6 m MSL	Data Collected	Analog Record	Instrument Status
865-1370	NOAA primary tide station located at seaward end of FRF pier.		Data Collected	Analog Record	Instrument Status

Instrument Status: Operational  - Daily Observation: YES   
Data Collected: ALL  , SOME

Analog Record: ALL  , PARTIAL   
Preliminary Analysis: ALL  , SOME

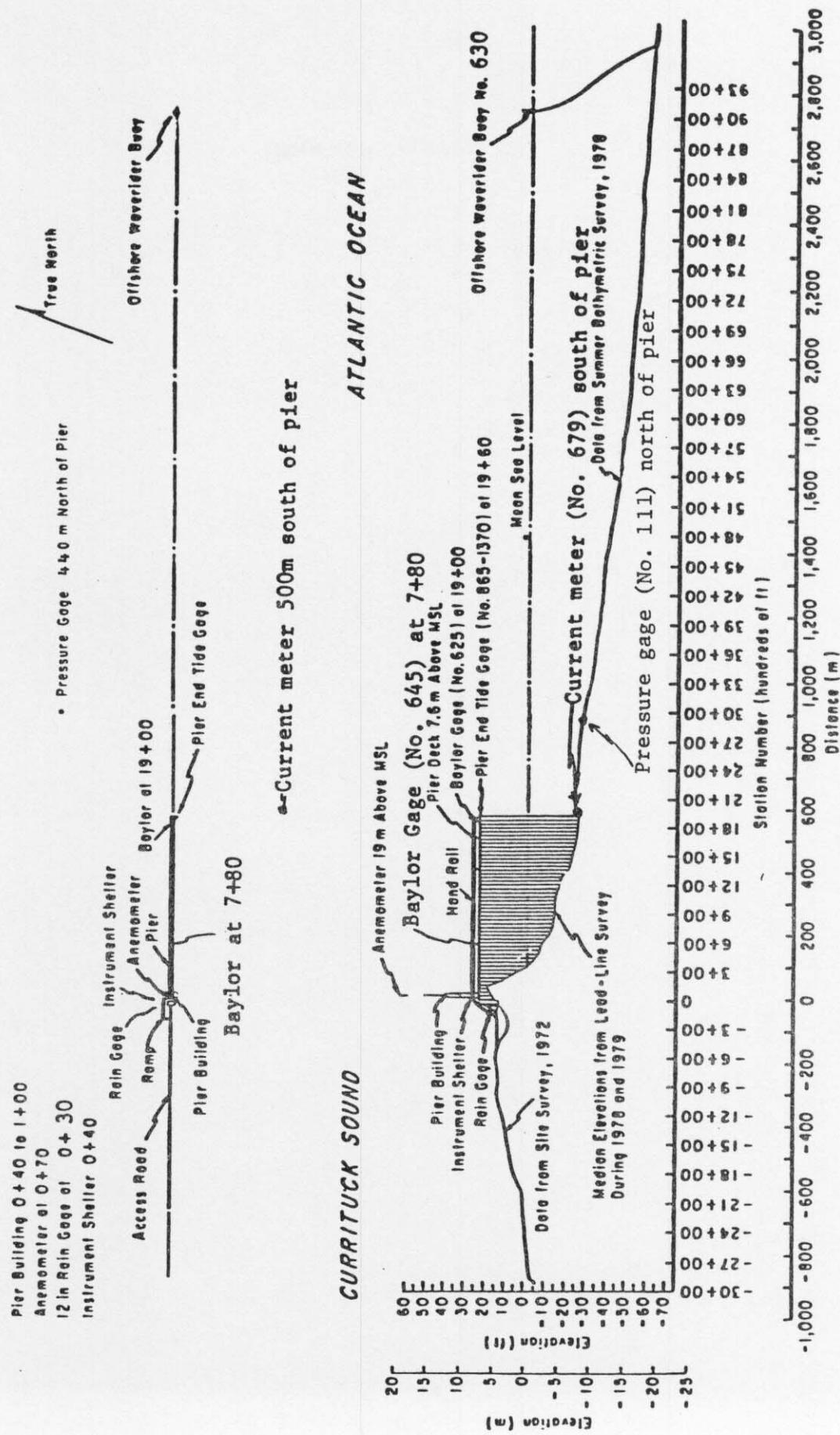


Figure 2. Instrument locations at FRF.

## II. METEOROLOGICAL DATA

A variety of instruments have been installed at the FRF (Fig. 2) to monitor the meteorological conditions. The data presented in Table 2 are collected and stored on magnetic tape using a Digital Equipment Corporation VAX 11/750. For each instrument identified in Table 1 as having analog outputs, chart records are obtained, a log is maintained and the records are stored for future reference.

The wind measurements are obtained from a Weather Measure Skyvane located on the FRF laboratory building (Fig. 2), 19.1 m above mean sea level (MSL).

The high and low temperatures are obtained from daily readings of NWS maximum and minimum thermometers and represent the extreme temperature values since the last reading.

The following may be useful for converting the data in Table 2 to other frequently used units of measurement:

1. Millimeters (mm) to inches (in) -  
 $mm \times .03937 = in$
2. Millibars (mb) to inches of mercury (in Hg) -  
 $mb \times 0.02953 = in Hg$
3. Degrees Celcius (C) to degrees Fahrenheit (F) -  
 $(C \times 9/5) + 32 = F$
4. Meters per second (m/s) to knots (kn) -  
 $m/s \times 1.943 = kn$

TABLE 2: Meteorological Data

SEP 1987

Day	Hour	Wind Speed m/s	Wind Direction deg TN	Temperature deg C	Atm Pressure mb	Precipitation mm
1	100	4	259	24.0	1015.2	0
	700	5	306	22.6	1015.5	0
	1300	7	28	24.5	1016.5	0
	1900	4	66	22.9	1016.9	0
2	100	4	126	22.5	1017.5	0
	700	3	117	23.8	1018.9	0
	1300	4	103	26.9	1018.2	0
	1900	4	125	24.7	1016.9	0
3	100	1	91	23.5	1017.2	0
	700	4	37	24.0	1018.6	0
	1300	7	36	25.8	1020.3	0
	1900	8	48	24.0	1020.6	0
4	100	11	58	23.3	1021.6	0
	700	13	56	23.1	1023.0	0
	1300	12	48	23.1	1023.3	0
	1900	11	39	22.1	1022.3	2
5	100	10	62	23.3	1020.3	7
	700	10	93	24.5	1021.3	0
	1300	10	87	24.1	1020.9	0
	1900	8	82	24.0	1020.6	0
6	100	8	104	23.9	1019.9	0
	700	5	109	24.7	1019.6	0
	1300	6	103	27.2	1019.2	0
	1900	5	109	24.7	1018.2	0
7	100	5	103	24.3	1017.5	0
	700	6	94	24.8	1017.5	0
	1300	5	105	27.9	1016.5	0
	1900	7	111	25.3	1014.8	0
8	100	5	129	24.7	1013.1	0
	700	7	146	24.9	1011.4	4
	1300	5	176	26.2	1010.1	5
	1900	5	192	25.7	1009.4	0
9	100	5	230	24.9	1011.4	0
	700	4	239	24.9	1012.1	0
	1300	1	208	31.1	1012.5	0
	1900	4	264	24.4	1013.1	0
10	100	2	348	22.8	1014.2	0
	700	4	297	24.1	1015.9	0
	1300	5	38	26.2	1016.5	0
	1900	3	59	24.3	1016.5	0
11	100	1	42	24.0	1017.2	0
	700	3	30	24.4	1018.6	0
	1300	2	87	28.2	1018.6	0
	1900	3	100	25.0	1018.2	0
12	100	2	136	24.3	1018.2	0
	700	4	125	25.3	1018.2	0
	1300	6	128	28.0	1017.5	0
	1900	3	141	26.0	1016.5	0
13	100	1	88	24.7	1015.9	0
	700	2	137	25.3	1015.5	0
	1300	2	181	25.3	1014.5	5
	1900	4	206	24.7	1013.8	2
14	100	5	257	24.5	1013.5	0
	700	4	305	24.5	1014.8	0
	1300	6	27	26.0	1016.2	0
	1900	6	63	24.1	1016.9	0
15	100	3	75	23.6	1018.2	0
	700	0		24.5	1019.6	0
	1300	3	125	28.6	1018.6	0
	1900	3	169	24.3	1017.9	0
16	100	4	210	24.6	1017.9	0
	700	4	230	25.4	1018.9	0
	1300	4	230	28.8	1017.2	0
	1900	6	204	26.2	1016.2	0

(Continued)

(Sheet 1 of 2)

TABLE 2: Meteorological Data

SEP 1987

Day	Hour	Wind Speed m/s	Wind Direction deg TN	Temperature deg C	Atm Pressure mb	Precipitation mm
17	100	5	227	24.6	1015.2	0
	700	5	213	25.3	1014.8	0
	1300	4	215	29.0	1012.1	0
	1900	4	194	26.4	1010.4	0
18	100	7	230	25.4	1009.1	0
	700	6	235	25.3	1007.7	0
	1300	4	229	30.1	1006.7	0
	1900	5	324	25.0	1007.7	0
19	100	7	277	25.1	1007.4	0
	700	2	9	23.3	1010.4	0
	1300	5	28	24.0	1011.8	0
	1900	8	51	22.7	1012.5	0
20	100	8	63	22.2	1011.4	0
	700	9	86	22.0	1010.8	9
	1300	7	73	24.3	1010.4	0
	1900	9	43	22.1	1010.8	0
21	100	6	33	21.9	1012.1	0
	700	5	10	21.9	1013.8	0
	1300	3	58	24.1	1014.8	0
	1900	5	114	21.8	1015.2	0
22	100	3	159	20.3	1015.9	0
	700	3	197	22.9	1015.9	0
	1300	3	183	27.6	1013.8	0
	1900	7	295	23.9	1012.1	0
23	100	6	296	19.1	1013.1	0
	700	7	302	17.1	1013.5	0
	1300	6	317	22.6	1013.5	0
	1900	3	298	20.4	1014.2	0
24	100	4	256	20.1	1014.5	0
	700	6	264	19.4	1014.2	0
	1300	7	246	23.8	1012.5	0
	1900	4	258	22.1	1011.4	0
25	100	4	283	20.1	1011.4	0
	700	4	293	19.6	1012.5	0
	1300	8	25	22.0	1014.2	0
	1900	5	17	19.5	1016.9	0
26	100	4	52	19.7	1018.9	0
	700	4	89	20.8	1020.6	0
	1300	5	118	24.1	1020.9	0
	1900	4	162	20.5	1020.3	0
27	100	3	262	20.8	1021.3	0
	700	3	39	21.2	1024.0	0
	1300	4	63	25.0	1024.3	0
	1900	5	102	22.1	1024.7	0
28	100	5	90	21.6	1025.3	0
	700	5	81	22.3	1026.3	0
	1300	4	90	26.2	1025.7	0
	1900	7	92	22.8	1024.3	0
29	100	6	84	22.0	1022.6	0
	700	3	69	23.1	1021.3	0
	1300	4	68	25.0	1017.5	0
	1900	4	114	22.1	1014.5	0
30	100	3	186	20.6	1010.8	0
	700	3	189	22.5	1008.1	0
	1300	7	211	21.4	1005.0	0
	1900	7	226	21.5	1003.7	0

(Sheet 2 of 2)

### III. WAVE DATA

Wave data are collected from two Baylor staff gages (Gages 625 and 645), a pressure wave gage (Gage 111) and a Waverider buoy (Gage 630) as shown in Table 1 and Figure 2. The data are collected, analyzed, and stored on magnetic tape using a Digital Equipment Corporation VAX 11/750 programmed to sample the wave gages every 6 hrs near 0100, 0700, 1300, and 1900 EST. The sampling rate is two times per second for 34 minutes.

Wave height ( $H_{mo}$ ) is an energy-based statistic equal to four times the standard deviation of the sea surface elevations. Wave height reported from the pressure gage has been compensated for hydrodynamic attenuation using linear wave theory. The wave period is identified from the computation of a variance (energy) spectrum with 60 deg of freedom calculated from a 34-min record. The period ( $T_p$ ) is that associated with the maximum energy density in the spectrum. When this analysis is complete, the data are written to magnetic tape.

Table 3 presents the wave heights and periods for each wave record obtained during the month. The monthly means and standard deviations from the means shown in Table 3 are average values computed for all data records collected. Figure 3 is a time history of the  $H_{mo}$  and  $T_p$  values for all gages.

Differences in wave periods between wave gages (Table 3 and Figure 3) may be the result of wave breaking, wave reformation, or the presence of multiple wave trains containing nearly equal energy.

TABLE 3: WAVE DATA

SEP 1987

Day	Hour	645		625		111		630	
		Baylor at 7+80 Hmo,m	T,sec	Baylor at 19+00 Hmo,m	T,sec	Pressure Gage Hmo,m	T,sec	Farshr Wvrdr Hmo,m	T,sec
1	0100	0.32	4.49			0.52	8.00	0.68	4.49
	0700	0.26	7.53			0.48	6.74	0.58	7.11
	1300	0.59	4.27			0.47	4.20	0.88	4.13
	1900	0.53	4.57			0.51	8.53	0.74	4.83
2	0100	0.39	5.02			0.49	4.74	0.62	8.26
	0700	0.35	4.66			0.51	8.26	0.59	9.14
	1300	0.33	5.69			0.46	5.45	0.60	5.45
	1900	0.32	4.57			0.46	8.53	0.55	5.69
3	0100	0.35	5.45			0.50	5.56	0.74	5.33
	0700	0.30	5.56			0.46	5.45	0.58	5.33
	1300	0.42	2.53			0.42	4.92	0.64	5.22
	1900	0.53	3.71			0.45	3.55	0.88	3.82
4	0100	1.00	5.22			0.86	5.12	1.56	5.33
	0700	1.30	5.69			1.42	5.69	1.83	6.09
	1300	1.27	6.09			1.48	6.40	2.04	6.09
	1900	1.21	5.95			1.53	5.95	1.91	6.24
5	0100	1.41	6.92			1.98	7.32	2.26	7.11
	0700	1.31	7.53			1.73	7.11	2.10	8.00
	1300	1.30	7.76			1.80	8.00	2.12	7.76
	1900	1.09	8.26			1.57	7.76	1.87	7.32
6	0100	1.16	5.56			1.49	7.53	1.71	7.53
	0700	1.06	12.20			1.47	8.53	1.64	8.26
	1300	1.20	11.14			1.71	11.14	1.80	8.26
	1900	1.11	11.14			1.48	9.14	1.58	10.66
7	0100	0.98	10.66			1.43	8.83	1.43	10.24
	0700	0.89	10.24			1.19	9.84	1.34	8.26
	1300	0.87	9.84			1.24	9.14	1.28	9.14
	1900	0.98	5.82			1.19	8.53	1.32	9.14
8	0100	0.94	8.53			1.11	6.92	1.43	6.74
	0700	0.88	5.95			1.03	8.53	1.38	8.53
	1300	0.91	5.12			1.07	6.57	1.34	6.74
	1900	0.76	6.92	Gage Inoperative		0.88	7.32	1.11	6.40
9	0100	0.58	7.32			0.79	7.76	0.85	6.09
	0700	0.56	4.92			0.75	7.53	0.80	8.26
	1300	0.42	14.22			0.67	7.32	0.60	8.26
	1900	0.41	13.48			0.66	13.48	0.70	7.32
10	0100	0.40	13.48			0.69	12.80	0.61	7.53
	0700	0.43	12.80			0.68	7.32	0.63	7.11
	1300	0.45	13.48			0.69	12.80	0.67	7.53
	1900	0.43	12.80			0.71	6.74	0.68	6.92
11	0100	0.41	12.80			0.65	12.80	0.55	6.74
	0700	0.39	12.20			0.61	12.20	0.57	6.09
	1300	0.33	12.20			0.56	12.20	0.45	12.20
	1900	0.34	12.20			0.54	12.80	0.52	12.20
12	0100	0.36	6.40			0.54	6.40	0.59	6.57
	0700	0.42	4.83			0.59	6.24	0.60	6.74
	1300	0.47	5.56			0.58	5.45	0.66	6.24
	1900	0.44	6.40			0.63	6.24	0.81	5.95
13	0100	0.46	9.84			0.68	6.74	0.71	8.26
	0700	0.59	10.24			0.96	9.84	0.82	9.48
	1300	0.68	10.24			1.08	9.84	1.02	10.24
	1900	0.59	10.24			1.14	10.24	0.93	11.14
14	0100	0.56	11.64			0.98	11.64	0.88	11.14
	0700	0.45	11.14			0.96	10.24	0.73	11.14
	1300	0.56	9.48			0.84	10.66	0.81	8.83
	1900	0.56	10.66			0.86	10.66	0.88	10.24
15	0100	0.51	9.84			0.75	9.84	0.77	9.84
	0700	0.40	9.84			0.63	9.84	0.65	9.84
	1300	0.38	10.24			0.61	8.00		*
	1900	0.39	9.84			0.65	9.14	0.69	9.14
16	0100	0.39	9.48			0.56	9.84	0.65	9.48
	0700	0.34	8.83			0.58	9.48	0.60	8.83
	1300	0.34	8.53			0.50	9.14	0.54	9.14
	1900	0.35	10.24			0.50	9.14	0.65	8.53

\* Electronic problems

(Continued)

(Sheet 1 of 2)

TABLE 3: WAVE DATA

SEP 1987

Day	Hour	645		625		111		630	
		Baylor	at 7+80	Baylor	at 19+00	Pressure Gage	Farshr	Wvrdr	
		Hmo,m	T,sec	Hmo,m	T,sec	Hmo,m	T,sec	Hmo,m	T,sec
17	0100	0.29	10.66			0.50	8.53	0.53	8.83
	0700	0.32	14.22			0.49	8.83	0.53	8.26
	1300	0.33	14.22			0.52	14.22	0.48	8.26
	1900	0.37	13.48			0.52	13.48	0.57	8.83
18	0100	0.34	12.80			0.51	13.48	0.59	8.83
	0700	0.32	12.80			0.54	11.64	0.55	11.14
	1300	0.34	10.24			0.67	9.84	0.52	10.24
	1900	0.44	9.48			0.64	9.48	0.65	9.84
19	0100	0.35	9.14			0.63	9.48	0.64	9.14
	0700	0.35	9.14			0.71	9.14	0.62	9.14
	1300	0.58	8.83			0.75	8.53	0.79	8.53
	1900	0.85	7.11			0.76	3.51	1.04	8.83
20	0100	0.95	8.26			1.06	7.53	1.35	8.26
	0700	1.03	8.53			1.09	8.53	1.26	8.53
	1300	0.93	7.32			1.03	8.00	1.29	7.76
	1900	1.08	8.00			1.06	4.49	1.40	7.32
21	0100	0.86	7.76			0.98	7.76	1.28	8.00
	0700	0.81	8.26			0.94	8.53	1.08	8.00
	1300	0.68	8.83			0.96	9.14	1.02	8.83
	1900	0.64	8.83			0.85	8.83	0.90	8.83
22	0100	0.51	9.14			0.83	9.48	0.85	9.14
	0700	0.48	9.14			0.87	9.14	0.72	8.26
	1300	0.42	9.48			0.75	8.53	0.68	9.14
	1900	0.43	9.84			0.76	9.48	0.73	9.14
23	0100	0.41	9.14			0.65	9.48	0.67	9.14
	0700	0.50	9.48			0.55	9.14	0.78	9.14
	1300	0.58	4.66			0.57	4.66	0.77	4.41
	1900	0.41	8.53			0.44	8.83	0.60	8.83
24	0100	0.33	8.53			0.46	9.14	0.50	8.83
	0700	0.26	9.84			0.46	8.26	0.45	8.26
	1300	0.24	13.48	0.36	9.84	0.45	9.48	0.46	9.14
	1900	0.24	14.22	0.33	9.14	0.46	9.84	0.41	9.14
25	0100	0.27	13.48	0.35	9.84	0.42	13.48	0.36	12.80
	0700	0.31	9.84	0.39	13.48	0.47	9.48	0.40	9.84
	1300	0.60	3.37	0.69	3.28	0.56	3.51	0.62	10.24
	1900	0.70	4.74	0.83	4.83	0.68	13.48	0.93	4.92
26	0100	0.66	5.82	0.72	11.64	0.74	11.64	0.88	11.64
	0700	0.54	10.24	0.74	12.80	0.76	12.80	0.83	10.24
	1300	0.52	10.66	0.70	11.14	0.87	11.14	0.86	9.84
	1900	0.49	9.48	0.70	9.48	0.76	9.84	0.85	9.48
27	0100	0.40	8.83	0.55	9.84	0.70	9.14	0.62	9.14
	0700	0.37	8.83	0.52	8.26	0.64	8.53	0.59	8.53
	1300	0.37	12.80	0.49	7.32	0.56	8.26	0.51	7.32
	1900	0.36	12.80	0.45	7.32	0.50	7.76	0.48	8.00
28	0100	0.35	12.80	0.44	7.76	0.46	7.53	0.47	7.32
	0700	0.42	2.94	0.49	6.92	0.52	6.92	0.53	7.11
	1300	0.34	12.80	0.43	12.20	0.44	11.64	0.46	6.74
	1900	0.54	2.69	0.57	12.20	0.45	12.20	0.67	6.24
29	0100	0.44	4.13	0.52	11.64	0.47	11.64	0.65	6.24
	0700	0.54	4.49	0.60	4.13	0.51	4.27	0.74	5.56
	1300	0.49	11.64	0.59	11.64	0.54	11.64	0.71	11.64
	1900	0.44	10.66	0.55	11.14	0.55	11.64	0.69	6.40
30	0100	0.46	8.00	0.71	7.76	0.76	8.00	0.84	7.76
	0700	0.55	7.76	0.77	7.76	0.90	7.76	0.92	7.53
	1300	0.45	7.76	0.65	8.00	0.68	7.76	0.82	7.53
	1900	0.44	8.83	0.61	7.76	0.71	8.00	0.85	8.00
Mean		0.57	8.82	0.57	9.12	0.78	8.75	0.87	8.13
Std dev		0.28	2.97	0.14	2.62	0.34	2.40	0.42	1.81

\* Electronic problems

(Sheet 2 of 2)

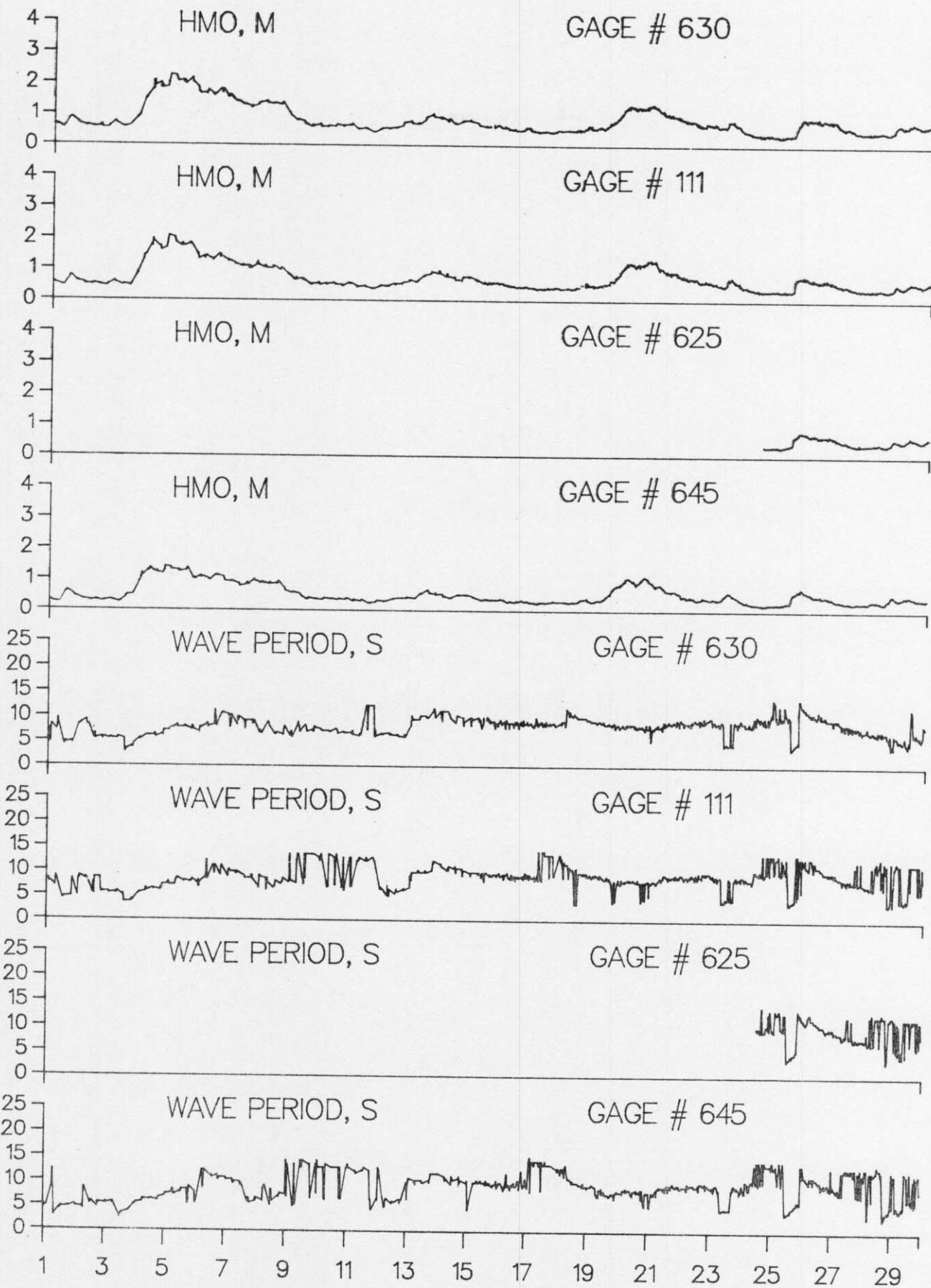


FIGURE 3. Time History of Wave Heights and Periods - September 1987

#### IV. CURRENT DATA

Current data (Table 4) are collected from a Marsh-McBirney electromagnetic biaxial current meter (Table 1 and Figure 2) and by visually observing the movement of dye on the water surface in the surf and at the seaward end of the pier, as well as 500 m updrift of the pier 12 m offshore.

Since the shoreline orientation is approximately N20W, alongshore currents flow either toward 340 (i.e. northward) or toward 160 (i.e. southward). Similarly, cross-shore currents are either onshore (westward) or offshore (eastward).

All current speeds are given in centimeters per second.

TABLE 4: Current Data  
SEP 1987

Day	Alongshore Cross-shore Resultant Time	Pier Measurements				Beach Measurements (500m Updrift)				Current Meter at South Tripod Depth -4.8m (NGVD) ID #679	
		Dye at (579 m) (surface) Speed	Dye at (surface) Dir	Distance from Baseline (m)	Speed	Dye 12m offshore (surface) Location	Speed	Dir	Speed	Dir	
1 0100	Along										
1 0700	Along	14	S on	140	22	S off	38	S			
1 1300	Along	14	177		22	157					
1 1900	Along										
2 0100	Along										
2 0700	Along	14	N off	152	32	N off	9	N			
2 1300	Along	14	346		33	351					
2 1900	Along										
3 0100	Along										
3 0700	Along	10	S on	152	44	N on	20	N			
3 1300	Along	11	179		2	337					
3 1900	Along										
4 0100	Along										
4 0700	Along	29	S on	152	25	S on	34	S			
4 1300	Along	15	187		9	179					
4 1900	Along										
5 0100	Along										
5 0700	Along	8	N on	262	61	N on	11	N			
5 1300	Along	8	295		15	326					
5 1900	Along										

KEY = All speeds in CM/SEC

N = Northward, Shore parallel

S = Southward, Shore parallel

on = onshore off = offshore

TABLE 4: Current Data  
SEP 1987

Alongshore Cross-shore Resultant Time Day	Pier Measurements						Beach Measurements (500m Updrift)			Current Meter at South Tripod Depth -4.8m (NGVD) ID #679	
	Dye at (579 m) (surface) Speed	Dir	Dye at Mid-Surf Zone (surface) Distance from Baseline (m)		Speed	Dir	Dye 12m offshore (surface) Location	Speed	Dir	Speed	Dir
6 0100-Along Cross Result											
6 0700-Along Cross Result	0			226	102	N		53	N		
6 1300-Along Cross Result	0	0			102	340	South				
6 1900-Along Cross Result											
7 0100-Along Cross Result											
7 0700-Along Cross Result	4 1 5	N on 326		189	102 10 102	N on 334		37	N		
7 1300-Along Cross Result											
7 1900-Along Cross Result											
8 0100-Along Cross Result											
8 0700-Along Cross Result	41 0 41	N on 340		152	61 9 62	N off 349	South	50	N		
8 1300-Along Cross Result											
8 1900-Along Cross Result											
9 0100-Along Cross Result											
9 0700-Along Cross Result	17 8 19	N off 4		140	41 6 41	N off 349		2	N		
9 1300-Along Cross Result											
9 1900-Along Cross Result											
10 0100-Along Cross Result											
10 0700-Along Cross Result	6 3 7	N off 7		165	5 1 5	S off 149	North	27	S		
10 1300-Along Cross Result											
10 1900-Along Cross Result											

KEY = All speeds in CM/SEC

N = Northward, Shore parallel

S = Southward, Shore parallel

on = onshore off = offshore

TABLE 4: Current Data  
SEP 1987

Day	Time	Pier Measurements				Beach Measurements (500m Updrift)				Current Meter at South Tripod Depth -4.8m (NGVD) ID #679	
		Dye at (579 m) (surface)	Speed	Dir	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir
11	0100-Along Cross Result										
11	0700-Along Cross Result	14 6 16	S on 184		165	7 2 7	S on 174		South	1	N
11	1300-Along Cross Result										
11	1900-Along Cross Result										
12	0100-Along Cross Result										
12	0700-Along Cross Result	15 0 15	S off 160		140	13 6 14	N on 313		South	52	N
12	1300-Along Cross Result										
12	1900-Along Cross Result										
13	0100-Along Cross Result										
13	0700-Along Cross Result	3 2 4	S off 133		152	29 7 30	S off 146		no observation		
13	1300-Along Cross Result										
13	1900-Along Cross Result										
14	0100-Along Cross Result										
14	0700-Along Cross Result	4 1 4	S off 141		238	0 0 0			South	28	S
14	1300-Along Cross Result										
14	1900-Along Cross Result										
15	0100-Along Cross Result										
15	0700-Along Cross Result	0 0 0			226	0 0 0			South	28	
15	1300-Along Cross Result										
15	1900-Along Cross Result										

KEY = All speeds in CM/SEC  
N = Northward, Shore parallel  
S = Southward, Shore parallel  
on = onshore off = offshore

TABLE 4: Current Data  
SEP 1987

Day	Time	Pier Measurements				Beach Measurements (500m Updrift)				Current Meter at South Tripod	
		Alongshore Cross-shore Resultant Speed	Dye at (579 m) (surface) Dir	Dye at Mid-Surf Zone (surface) Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface) Location	Speed	Dir	Depth -4.8m (NGVD) ID #679	Speed
16	0100-Along Cross Result										
16	0700-Along Cross Result	25 0	N 340	165	34 0	S 160		37	S		
16	1300-Along Cross Result										
16	1900-Along Cross Result										
17	0100-Along Cross Result										
17	0700-Along Cross Result	8 0 8	N 340	140	28 7 29	N on 326		40	N		
17	1300-Along Cross Result										
17	1900-Along Cross Result										
18	0100-Along Cross Result										
18	0700-Along Cross Result	0 10 10	- on 250	152	11 34 36	N on 267		9	S		
18	1300-Along Cross Result										
18	1900-Along Cross Result										
19	0100-Along Cross Result										
19	0700-Along Cross Result	38 0 38	S - 160	140	22 5 22	N off 354		no observation			
19	1300-Along Cross Result										
19	1900-Along Cross Result										
20	0100-Along Cross Result										
20	0700-Along Cross Result	11 8 14	S on 197	152	30 15 34	S on 187		30	S		
20	1300-Along Cross Result										
20	1900-Along Cross Result										

KEY = All speeds in CM/SEC  
N = Northward, Shore parallel  
S = Southward, Shore parallel  
on = onshore off = offshore

TABLE 4: Current Data  
SEP 1987

Day	Time	Pier Measurements				Beach Measurements (500m Updrift)				Current Meter at South Tripod	
		Alongshore Cross-shore Resultant	Dye at (579 m) (surface) Speed	Distance from Baseline (m)	Dye at Mid-Surf Zone (surface) Speed	12m offshore (surface) Location	Speed	Dir	Depth -4.8m (NGVD) ID #679	Speed	Dir
21	0100-Along Cross Result										
21	0700-Along Cross Result	25 0 25	S off 160	226	32 3 32	S on 166	30	S	North		
21	1300-Along Cross Result										
21	1900-Along Cross Result										
22	0100-Along Cross Result										
22	0700-Along Cross Result	6 6 9	N off 25	189	14 11 18	N on 303	30		North		
22	1300-Along Cross Result										
22	1900-Along Cross Result										
23	0100-Along Cross Result										
23	0700-Along Cross Result	30 6 31	S off 149	177	23 2 23	S on 166	39	S	North		
23	1300-Along Cross Result										
23	1900-Along Cross Result										
24	0100-Along Cross Result										
24	0700-Along Cross Result	10 4 11	N off 4	177	5 3 6	S off 129	39		North		
24	1300-Along Cross Result										
24	1900-Along Cross Result										
25	0100-Along Cross Result										
25	0700-Along Cross Result	8 2 8	S off 146	165	12 1 13	S off 154	23	S	North		
25	1300-Along Cross Result										
25	1900-Along Cross Result										

KEY = All speeds in CM/SEC  
N = Northward, Shore parallel  
S = Southward, Shore parallel  
on = onshore off = offshore

TABLE 4: Current Data  
SEP 1987

Alongshore Cross-shore Resultant	Pier Measurements						Beach Measurements (500m Updrift)			Current Meter at South Tripod	
	Dye at (579 m) (surface)		Dye at Mid-Surf Zone (surface)		Dye 12m offshore (surface)		Location		Speed	Dir	Depth -4.8m (NGVD)
Time	Day	Speed	Dir	Distance from Baseline (m)	Speed	Dir	Location	Speed	Dir	Speed	Dir
26 0100-Along Cross Result											
26 0700-Along Cross Result	26	10 2 10	N on 326	213	14 2 14	N off 349	30 N North				
26 1300-Along Cross Result										0 2 2	off 70
26 1900-Along Cross Result										15 2 15	N on 332
27 0100-Along Cross Result	27									6 2 6	N on 322
27 0700-Along Cross Result	27	8 7 11	N on 298	189	3 0 3	N off 349	9 N North	8 1 8	N on 333		
27 1300-Along Cross Result										1 0 1	S 160
27 1900-Along Cross Result										6 1 6	N on 331
28 0100-Along Cross Result	28									2 1 2	N on 313
28 0700-Along Cross Result	28	14 5 15	N on 321	207	12 4 12	N on 323	14 N South	10 2 10	N on 329		
28 1300-Along Cross Result										8 0 8	N 340
28 1900-Along Cross Result										12 2 12	N on 331
29 0100-Along Cross Result	29									7 1 7	N on 332
29 0700-Along Cross Result	29	8 4 9	N on 316	226	13 7 15	N on 313	27 N South	8 2 8	N on 326		
29 1300-Along Cross Result										6 1 6	N off 349
29 1900-Along Cross Result										9 1 9	N off 346
30 0100-Along Cross Result	30									6 0 6	N 340
30 0700-Along Cross Result	30	36 2 36	N off 343	226	61 15 63	N off 354	50 N South	11 2 11	N on 330		
30 1300-Along Cross Result										11 5 12	N on 316
30 1900-Along Cross Result										10 5 11	N on 313

KEY = All speeds in CM/SEC  
 N = Northward, Shore parallel  
 S = Southward, Shore parallel  
 on = onshore off = offshore

## V. SUPPLEMENTAL OBSERVATIONS

Visual wave direction measurements (Table 5) taken at the seaward end of the pier are made of both the primary wave train (i.e. that having the larger wave heights) and the secondary wave train (which must be clearly distinguishable as a wave train separate from the primary waves) but not surface chop or capillary waves. The direction of the primary wave train just north of the seaward end of the pier is also determined using a Raytheon Marine Pathfinder radar and measuring alignment of the wave crests. The pier axis (considered perpendicular to the beach at the FRF) is orientated 70 east of true north; consequently, wave angles greater than 70 imply the waves were coming from the south side of the pier.

The width of the surf zone (seawardmost breaker position to shoreline) is determined from the pier deck.

Measurements of surface water temperature, density, and visibility are made daily at the seaward end of the FRF pier. A jar along with a thermometer is lowered about .3 m (1 ft) into the water and allowed to remain for at least one minute. The jar is removed, the temperature read and a hydrometer is used to determine the density. A secci disc is used to determine the surface visibility.

TABLE 5: Supplemental Observations

SEP 1987

DAY	TIME	WAVE APPROACH		RADAR WAVE ANGLE deg from True N	WIDTH OF SURF ZONE, m	WATER CHARACTERISTICS AT PIER END		
		ANGLE AT PIER END deg from True N Primary	Secondary			TEMP, C	DENSITY g/cc	SECCI VIS, m
1	807	20			34	25.0	1.0204	3.0
2	815	60	120		34	25.0	1.0204	3.0
3	643	100			34	25.0	1.0204	3.7
4	624	50			46	25.0	1.0204	2.4
5	1000	100		95	329	23.4	1.0212	0.9
6	830	100		100	134	25.0	1.0202	2.7
7	900	95		100	122	23.9	1.0208	4.6
8	632	90		90	79	24.7	1.0202	2.4
9	647	110			29	23.9	1.0210	1.8
10	703	90		100	24	23.9	1.0208	2.7
11	710	100			18	25.3	1.0204	2.7
12	645	70			43	26.1	1.0192	4.0
13	900	70		inoperative	85	25.6	1.0196	5.2
14	624	90	50		40	25.0	1.0203	2.7
15	657	80	50		73	25.6	1.0200	6.4
16	730	90			49	25.6	1.0204	4.6
17	800	none visible			24	23.4	1.0222	3.7
18	824	90			40	22.2	1.0220	3.7
19	745	75			37	22.8	1.0216	3.7
20	845	55		55	98	23.4	1.0216	2.1
21	658	40	80	65	30	23.9	1.0202	3.7
22	641	90	50		55	24.5	1.0204	4.0
23	726	50	0	60	49	23.4	1.0210	3.0
24	725	45			15	24.0	1.0210	7.0
25	747	none visible			6	23.4	1.0210	5.8
26	937	40	110		21	23.6	1.0210	6.4
27	1000	none visible			55	24.1	1.0210	6.1
28	639	100		60	46	23.4	1.0208	4.0
29	552	100	50		122	23.4	1.0210	4.6
30	703	100			67	23.4	1.0210	3.7

## VI. WATER LEVELS

The National Ocean Services (NOS) has established a primary tide station (No. 865-1370) at the seaward end of the FRF pier. A Leupold-Stevens digital recording float-type tide gage is used to collect data every 6 minutes throughout the month.

Figure 4 shows the variation in mean water levels computed over a tidal cycle period (12.42 hours), and contains a list of selected mean and extreme values. This presentation is useful in identifying effects on both meteorological and astronomical forces on the open coast water levels.

Table 6 contains the time of the center of each sampling interval and the range, high, low, and mean water levels during each tidal cycle.

## FRF TIDE HEIGHTS

SEP 1987

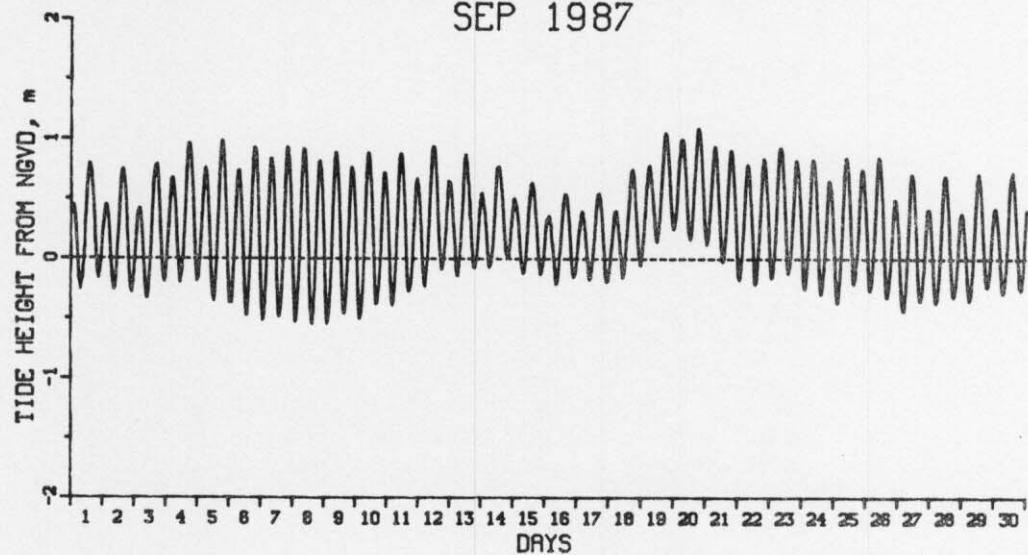


FIGURE 4. Time History of Mean Water Levels, September 1987

### MONTHLY WATER LEVELS (METERS NGVD)

EXTREME LOW	= -0.55 ON DAY 8 AT 1406HRS.
EXTREME HIGH	= 1.09 ON DAY 20 AT 1748HRS.
MONTHLY MEAN	= 0.25
MEAN LOW	= -0.24
MEAN HIGH	= 0.78
MEAN RANGE	= 1.02

Table 6: WATER LEVELS, METERS NGVD

		SEP	1987		
MID-CYCLE	DAY TIME	LOW	HIGH	MEAN	RANGE
1	612	-0.26	0.76	0.18	1.02
1	1837	-0.16	0.79	0.27	0.96
2	703	-0.26	0.70	0.15	0.96
2	1928	-0.28	0.75	0.19	1.03
3	753	-0.33	0.69	0.11	1.02
3	2018	-0.19	0.79	0.29	0.98
4	843	-0.20	0.76	0.28	0.96
4	2109	-0.19	0.96	0.39	1.15
5	934	-0.35	0.76	0.23	1.11
5	2159	-0.37	0.98	0.28	1.36
6	1024	-0.48	0.74	0.17	1.21
6	2249	-0.52	0.93	0.22	1.44
7	1115	-0.48	0.84	0.19	1.32
7	2340	-0.53	0.93	0.21	1.46
8	1205	-0.55	0.92	0.19	1.47
9	30	-0.55	0.82	0.16	1.36
9	1255	-0.46	0.89	0.20	1.35
10	121	-0.50	0.77	0.15	1.27
10	1346	-0.38	0.88	0.23	1.26
11	211	-0.39	0.76	0.19	1.15
11	1436	-0.27	0.87	0.26	1.15
12	301	-0.23	0.83	0.26	1.06
12	1527	-0.09	0.94	0.39	1.03
13	352	-0.15	0.78	0.28	0.93
13	1617	-0.08	0.87	0.34	0.95
14	442	-0.08	0.71	0.27	0.79
14	1707	0.02	0.77	0.36	0.75
15	532	-0.12	0.52	0.20	0.64
15	1758	-0.13	0.63	0.23	0.77
16	623	-0.21	0.38	0.11	0.59
16	1848	-0.16	0.54	0.19	0.69
17	713	-0.18	0.40	0.14	0.58
17	1938	-0.20	0.55	0.17	0.74
18	804	-0.16	0.49	0.17	0.65
18	2029	-0.05	0.75	0.35	0.80
19	854	0.14	0.81	0.49	0.67
19	2119	0.25	1.05	0.64	0.80
20	944	0.16	1.00	0.60	0.84
20	2210	0.12	1.09	0.60	0.97
21	1035	-0.02	0.94	0.45	0.97
21	2300	-0.18	0.91	0.35	1.09
22	1125	-0.21	0.79	0.31	1.00
22	2350	-0.16	0.84	0.35	1.01
23	1216	-0.12	0.93	0.40	1.05
24	41	-0.25	0.82	0.29	1.08
24	1306	-0.30	0.83	0.25	1.13
25	131	-0.37	0.80	0.17	1.17
25	1356	-0.21	0.84	0.31	1.05
26	222	-0.27	0.82	0.25	1.09
26	1447	-0.32	0.85	0.19	1.17
27	312	-0.44	0.69	0.06	1.12
27	1537	-0.35	0.71	0.11	1.06
28	402	-0.37	0.67	0.07	1.04
28	1628	-0.32	0.69	0.11	1.01
29	453	-0.35	0.67	0.07	1.02
29	1718	-0.24	0.71	0.18	0.95
30	543	-0.29	0.67	0.12	0.96
30	1808	-0.27	0.72	0.18	0.99

## VII. NEARSHORE PROFILES

A. Nearshore Profiles. In order to document profile response away from the pier, surveys of four profile lines extending 900 to 1,000 m from shore and located 489 and 581 m north and 517 and 608 m south of the FRF pier are conducted bi-weekly, after storms, and during more complete bathymetric surveys.

These profiles are obtained using the CRAB-Zeiss surveying system; a Zeiss Elta-2 first-order, self-recording electronic theodolite distance meter in combination with the Coastal Research Amphibious Buggy (CRAB), a 10.7 m high, self-powered, mobile tripod on wheels.

Figure 5 shows the last survey in August and the two surveys in September on profile line 188, located 517 m south of the pier. A small amount of accretion is visible along the entire foreshore (80 to 140 m). In addition, the nearshore bar (200 m) migrated 40 m shoreward. Only minor changes are visible on the remainder of the profile line.

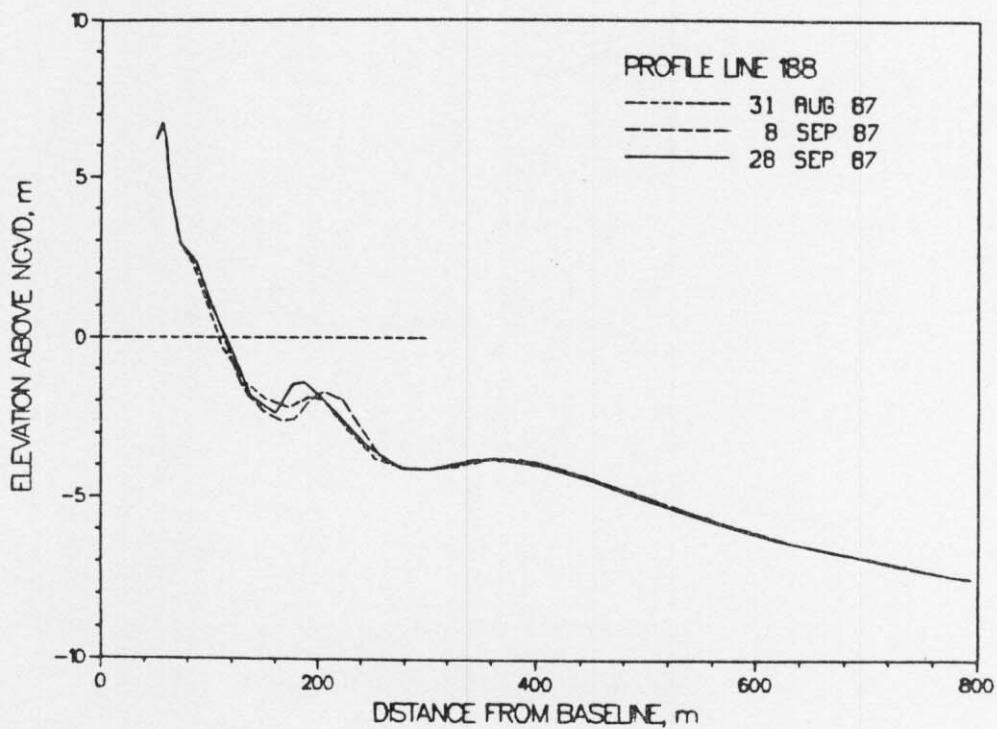


Figure 5. Monthly CRAB profiles on profile 188 - 517 meters south of pier.

The profile envelope (Figure 6) reflects the maximum changes that occurred on the profile during 1987. The solitary change to the envelope (200 m) is a result of the shoreward migration of the nearshore bar.

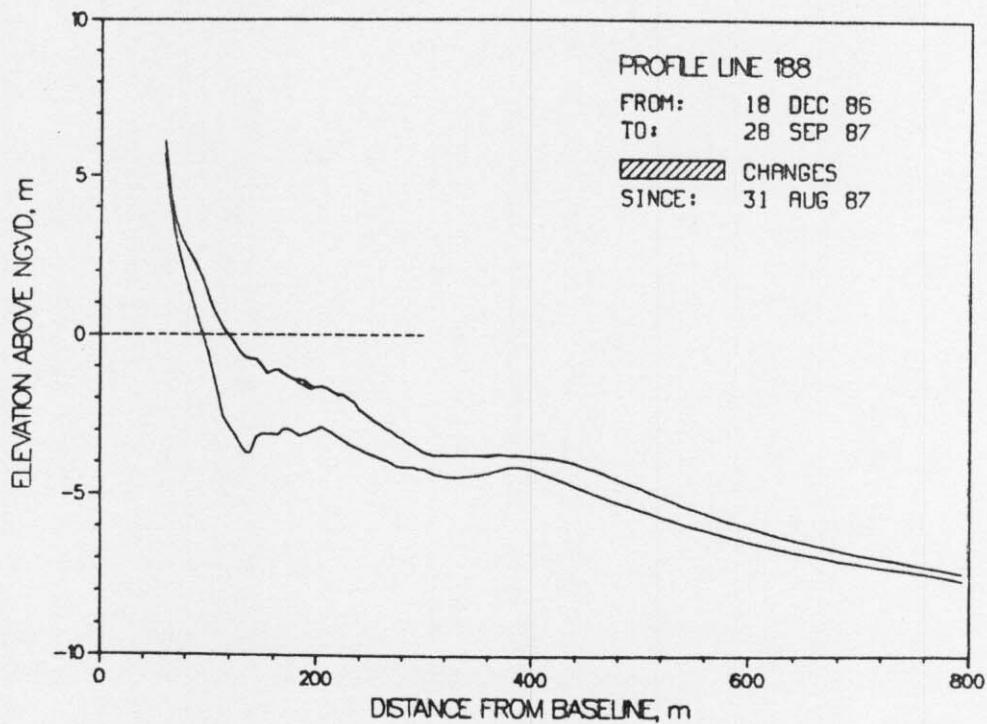


Figure 6. CRAB profile envelope - profile 188.

B. Bathymetry. Figure 7 is a contour map showing the bathymetric survey of 1 September 87.

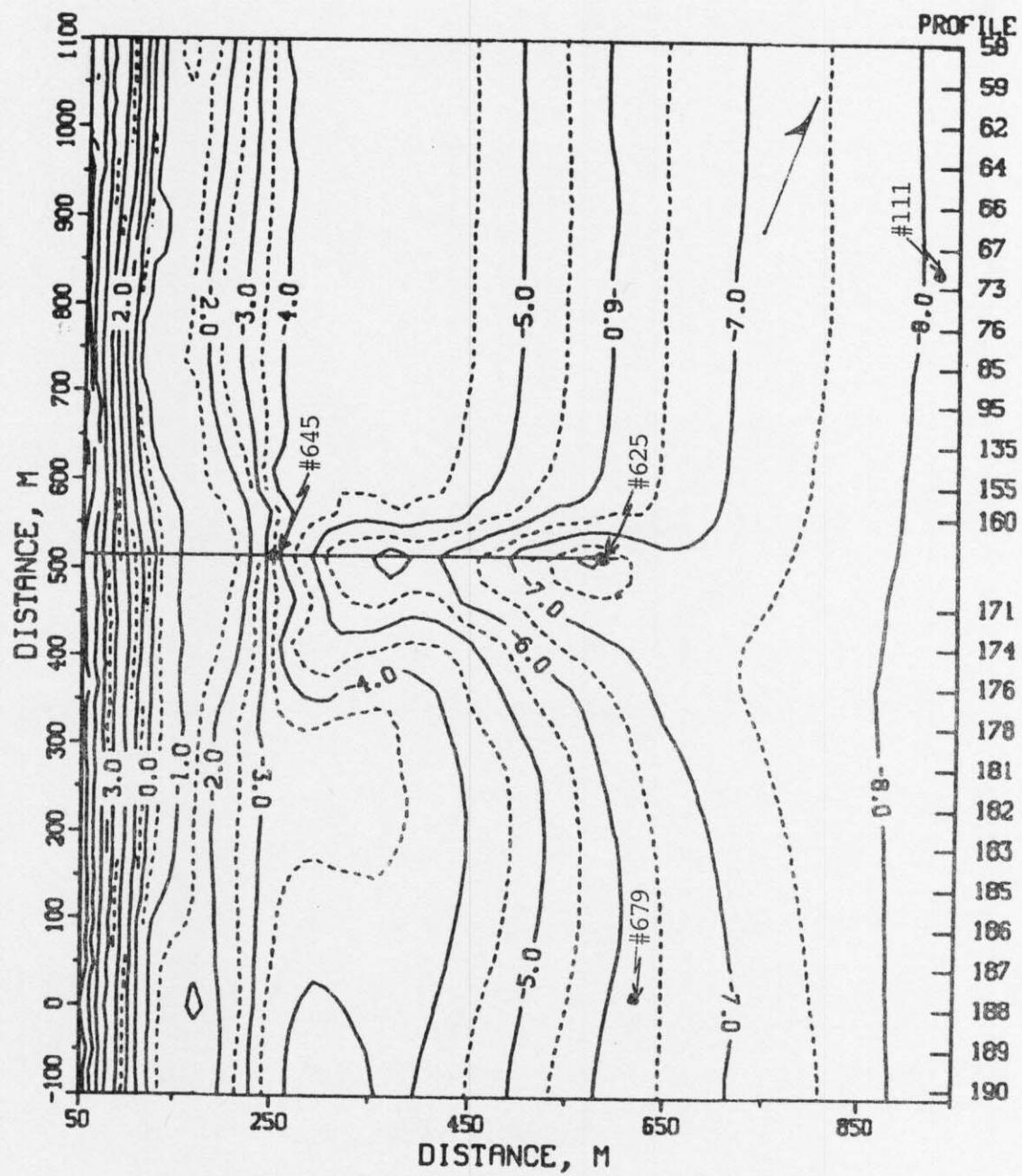


FIGURE 7. FRF BATHYMETRY 1 SEP 87  
CONTOURS IN METERS

## VIII. SPECIAL EVENTS

A. Storm Data Collection. The following list identifies times when the wave height at the seaward end of the pier (i.e. as measured by the Baylor Gage #625 at pier station 19+00) exceeded 2 m. When this occurred, four contiguous 34-min wave records were obtained every three hours:

Start	End
4 Sep (2042)	4 Sep (0134)

B. Storm Synopsis.

4-5 September: Strong onshore winds generated by a strong Canadian high pressure system briefly produced storm waves at the FRF. The maximum wind speed of 13 m/s (NE) was recorded at 2200 hrs on 4 September. On that same day, the maximum Hmo of 2.06 m (period = 7.11 sec) at Gage #111 occurred at 2042 hrs.

### Distribution List

#### Government Agencies:

OCE  
BERH  
NAO  
NASA/Wallops Flight Center  
NOAA (NOS, NWS)  
SAD  
SAW

U.S. Geological Survey  
U.S. National Park Service  
U.S. Naval Academy  
U.S. Naval Civil Eng. Lab  
U.S. Naval Fac. Eng. Com.  
U.S. Naval Oceanographic Off.  
U.S. Naval Research Lab

#### Colleges/Universities:

California Inst. of Tech.  
East Carolina University  
Florida Inst. of Tech.  
Harvard University  
Naval Post Graduate School  
NC State University  
Old Dominion University  
Oregon State University  
Prince George's College  
Rutgers University  
Scripps Inst. of Oceanography  
Southern Illinois University

Stockton State College  
University of Akron  
University of Delaware  
University of Florida  
University of Maryland  
University of Miami  
University of North Carolina  
University of N. Colorado  
University of Rhode Island  
University of Virginia  
Va. Inst. of Marine Science

#### Others:

City of Va. Beach, VA  
Coastal Barge Corporation  
Coastal and Est. Res., Inc.  
Coastal Science & Eng., Inc.  
Cedar Ocean Sensors Ltd.  
Dr. Galvin  
GEOMET Tech., Inc.  
Greenhorne & O'Mara, Inc.  
Dr. Hylton  
Mary Marr, Inc.  
Masonite Corporation

MEC Systems Corporation  
Moffatt & Nichol, Eng.  
Offshore Coastal Technologies  
Mr. Rowland  
Mr. Savage  
Sea Port Supply Corp.  
Shell Development  
Sherwood Industries  
Sohio Petroleum Co.  
Mr. & Mrs. Valpey  
WCTI-TV

#### Foreign:

W. F. Baird & Asso. Coastal Engineers, Ltd (Canada)  
Queen's University, Ontario (Canada)  
Ministry of Construction, Coastal Division (Japan)  
Norwegian Hydrodynamic Laboratories (Norway)  
University of New South Wales (Australia)  
University of Sydney (Australia)